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ON FEATURES OF THE GENERATION OF ARTIFICIAL IONOSPHERIC IRREGULARITIES WITH TRANSVERSE SCALES OF 50–200 m

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We consider the features of generation of artificial ionospheric irregularities with transverse (to the geomagnetic field) scales $l_\perp \approx 50$–200 m in the ionosphere modified by high-power HF radio waves. It was found that there are at least two mechanisms for generation of these irregularities in the ionospheric F region. The first mechanism is related to the resonant interaction between radio waves and the ionospheric plasma, while the second one takes place even in the absence of the resonant interaction. Different polarization of the high-power radiation was used to separate the mechanisms in the measurements.

1. INTRODUCTION

Among a variety of the effects observed during modification of the Earth's ionosphere by high-power radio waves, the generation of artificial ionospheric irregularities is one of the most important ones. They are excited in a wide range of transverse (to the geomagnetic field) scales (from fractions of a meter to ten or more kilometers) and affect the propagation of radio waves of different frequency ranges. The properties of these irregularities have been studied by many authors. These studies were the basis for determining the spectral characteristics during excitation of irregularities in the evening and nighttime conditions near the height of reflection of the O-mode high-power radio wave, when the pump-wave frequency is outside the regions of resonances with the electron gyrofrequency harmonics [1–4]. In particular, the existence of two spectral maxima was found, one of which is detected in the scale range $l_\perp \approx 30$–50 m and is due to the development of the thermal (resonant) parametric instability [5–7] and the second belongs to the scale range $l_\perp \approx 300$–800 m and is due to the self-focusing instability of the high-power radio wave [8–10]. The mechanism of generation of artificial ionospheric irregularities in the intermediate-scale range $l_\perp \approx 50$–200 m remained unexplored until recent time. It was shown in [11–13] that these irregularities have a high intensity and cause strong scattering of the probing radio waves of both polarizations which sound the disturbed ionospheric region at frequencies close to the pump-wave frequency.

This paper aims at determining the features of generation of artificial ionospheric irregularities with the scales $l_\perp \approx 50$–200 m. The experimental data considered in this paper were obtained for the ionosphere modified by means of the SURA heating facility. In Sec. 2, we present the methods of diagnostics of such irregularities and consider the capabilities and limitations of these techniques. Also, we discuss the ionospheric modification regimes which we used to solve the problem.

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